Specialization	Electrical Engineering
Course Name:	Power Electronics
Date:	24/11/2011
Time:	11:00-12:00
Instructor:	Dr. Anees Abu Sneineh



Palestinian National Authority
Ministry of Education & Higher Education
Palestine Technical University
College of Engineering & Technology
Second Exam
First Semester 2011/2012

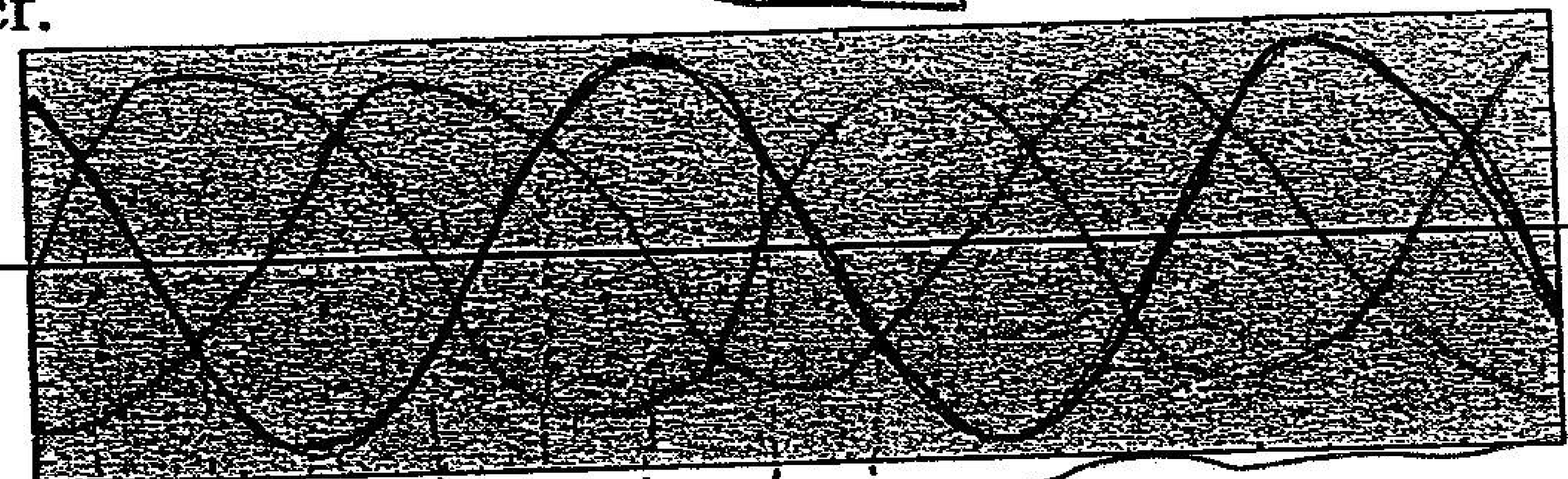
Power Electronics 2nd Exams

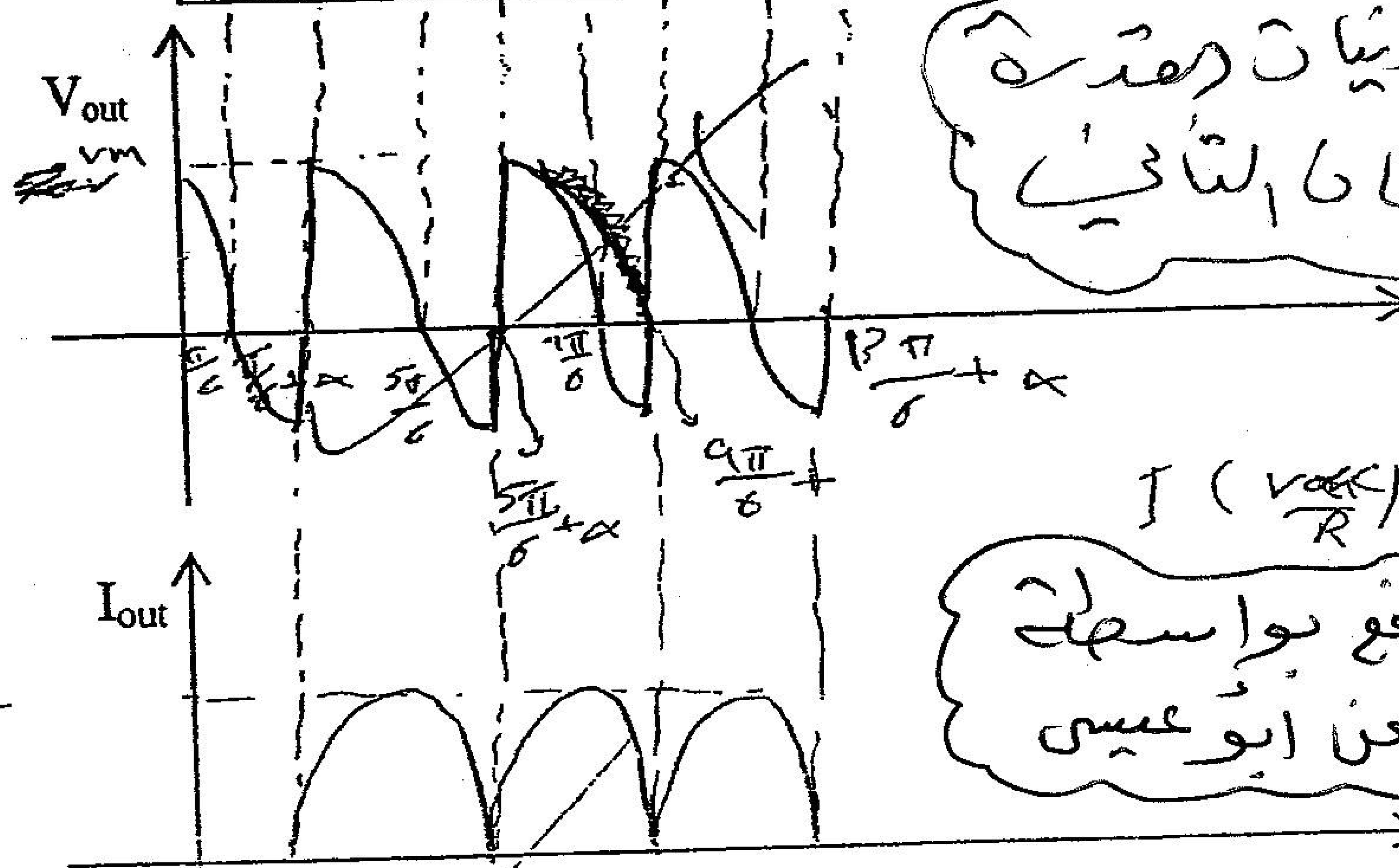
Name:	[redacted]	Section:		21 /25

Q1. For Three-Phase Half-Wave Controlled Rectifier, V_m=50V, R=4.5Ω: (10-marks) 8

21/25

a. Draw the output voltage and current waveforms for RL-load.
b. b. Draw the region of operation for this converter.
c. Find V_{dc}, V_{rms} when $\alpha = \pi/6$
d. Find FF, RF, TUF, PIV





الكلاديات مقدمة
للامتحان الثاني

$I\left(\frac{V_{dc}}{R}\right)$

تم الرفع بواسطة
م. معن ابو عيسى

$c = \frac{3\sqrt{3}\,V_m}{2\pi}\cos\alpha$

$= \frac{3\sqrt{3}*50}{2\pi}\cos\frac{\pi}{6}$

$= \boxed{35.81\,V}$

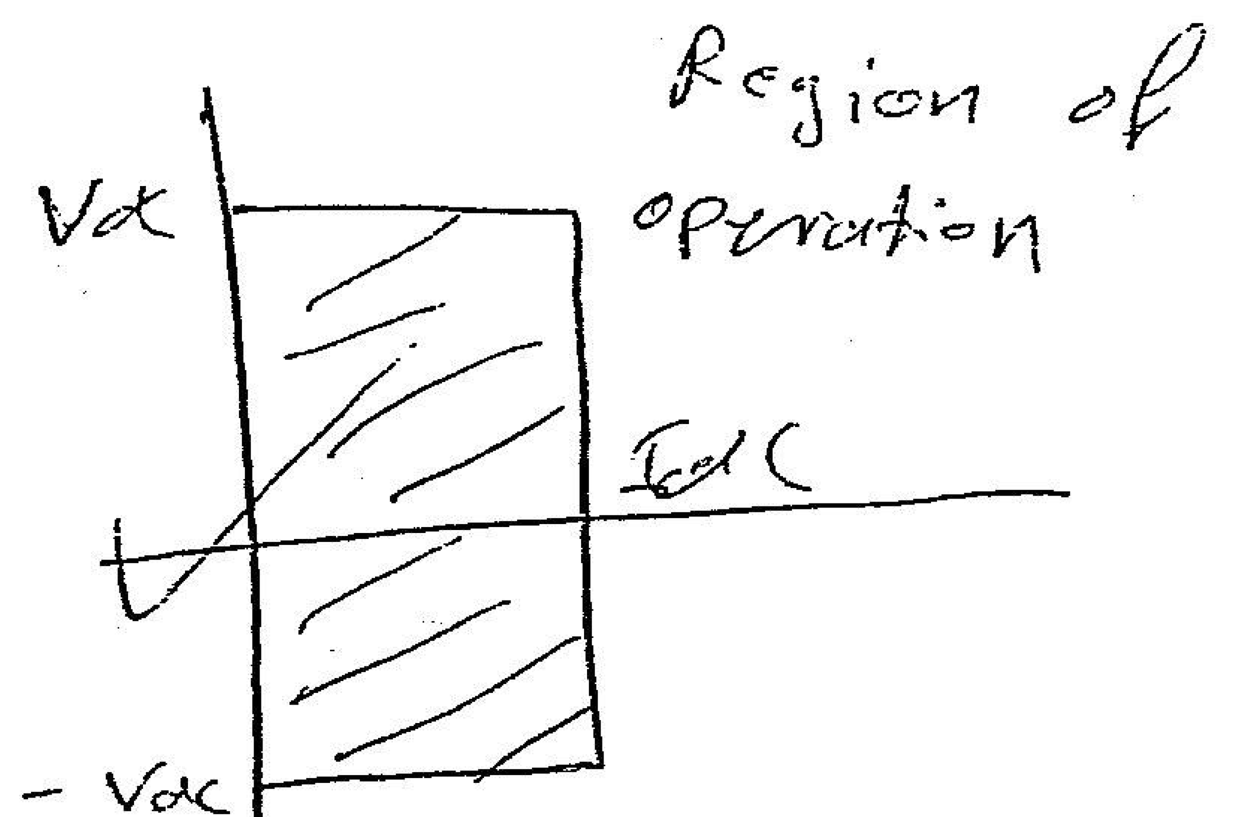
$V_{rms} = \sqrt{3}\,V_m\sqrt{\frac{1}{6}+\frac{\sqrt{3}}{8\pi}\cos 2\alpha}$

$\sqrt{3}*50\sqrt{\frac{1}{6}+\frac{\sqrt{3}}{8\pi}\cos\left(\frac{2\pi}{6}\right)}$

$\sqrt{3}*50\sqrt{\frac{1}{6}+0.034458}$

$= \boxed{38.84\,V}$

Region of operation



V is positive or negative

Idc just postive

~~V.A. = Vs. Is = 79.184~~

~~I = 128.23 / 79~~

$FF = \frac{V_{rms}}{V_{dc}} = \frac{38.84}{35.81}$

$= 1.085$ ~~= 108.5%~~

$RF = \sqrt{FF^2 - 1} = 0.42 = 42\%$

$TUF = \frac{P_{dc}}{V.A\ rating}$

$P_{dc} = V_{dc}.I_{dc} = \frac{35.81 * 35.81}{4.5}$

$= 284.97\,W$

$V_s = \frac{V_m}{\sqrt{2}} = 35.35\,V$

$I_s = \frac{I_{rms}}{\sqrt{3}} = \frac{\left(\frac{V_{rms}}{R}\right)}{\sqrt{3}} = 4.98\,A$

V.A rating = 3 Vs Is

$= 35.35 * 4.98 = 176.043$

$TUF = \frac{284.97}{176.043} = 1.619$

$PIV = \sqrt{3}\,V_m = -50$

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Q2. The Input current in Fourier series for a Three-Phase Full Converter with RL-load is: (3-marks) 3

$$i_s(t) = \frac{\sqrt{2}I_a}{\pi} + \sum_{n=1,3,5...}^{\infty} \frac{4I_a}{n\pi}\sin\frac{n\pi}{2}\left[\cos(n\alpha)\sin(n\omega t) - \sin(n\alpha)\cos(n\omega t)\right]$$

When $\alpha=\pi/3$, $I_s=I_a$, and **DF=1**. Find the Harmonic factor and the Input Power factor.

$= I_a$

$HF = \sqrt{\left(\frac{I_s}{I_{s1}}\right)^2 - 1}$

$PF = \frac{I_{s1}}{I_s} \cdot \cos\phi = \frac{I_{s1}}{I_s}$

$= \frac{\sqrt{2} I_a}{\pi} + \frac{4 I_a}{\pi} \times \sin\frac{\pi}{2}\left[\cos\left(\frac{\pi}{3}\right)\sin\left(\frac{\pi}{3}\right) - \sin\left(\frac{\pi}{3}\right)\cos\left(\frac{\pi}{3}\right)\right]$

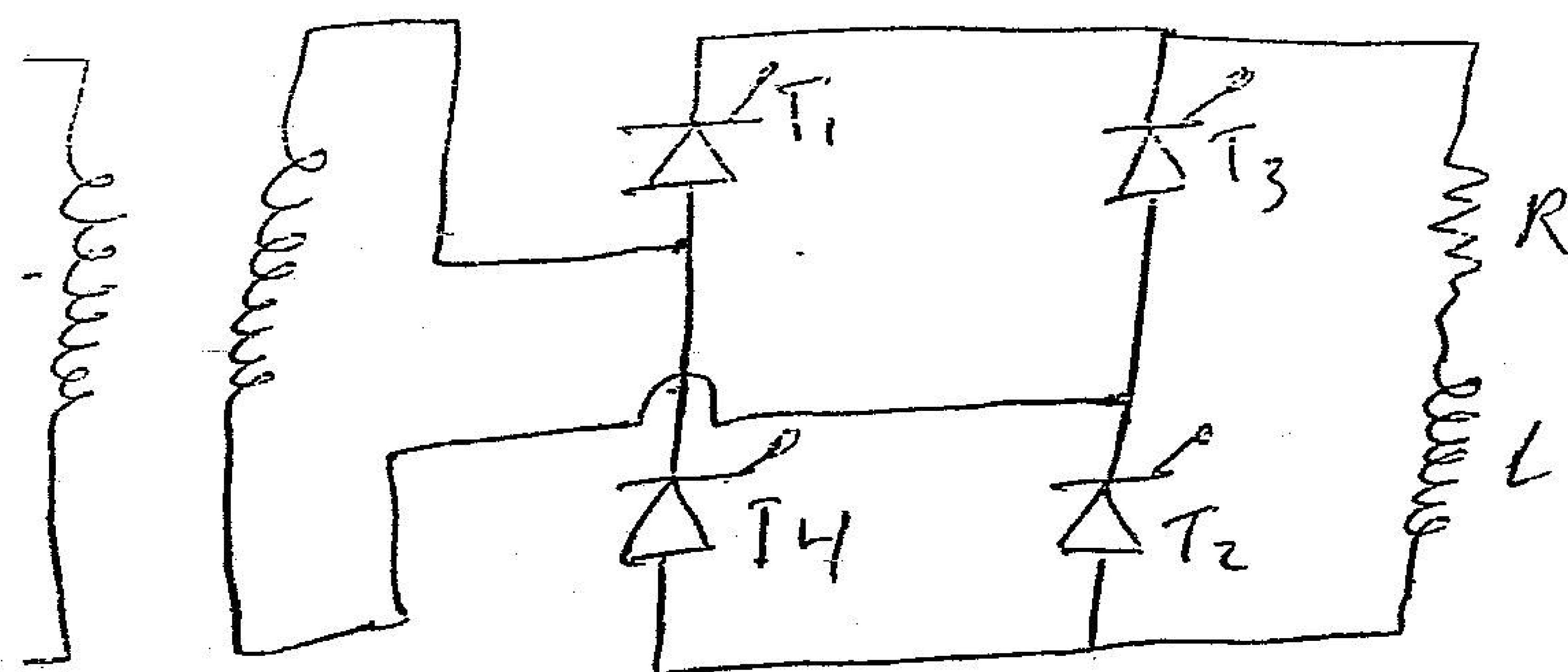
$= \frac{\sqrt{2} I_a}{\pi} + \frac{4 I_a}{\sqrt{2}\pi} = \frac{4 I_a}{\sqrt{2}\pi}$

$HF = \sqrt{\left(\frac{I_a}{\frac{4 I_a}{\sqrt{2}\pi}}\right)^2 - 1} = 0.47$

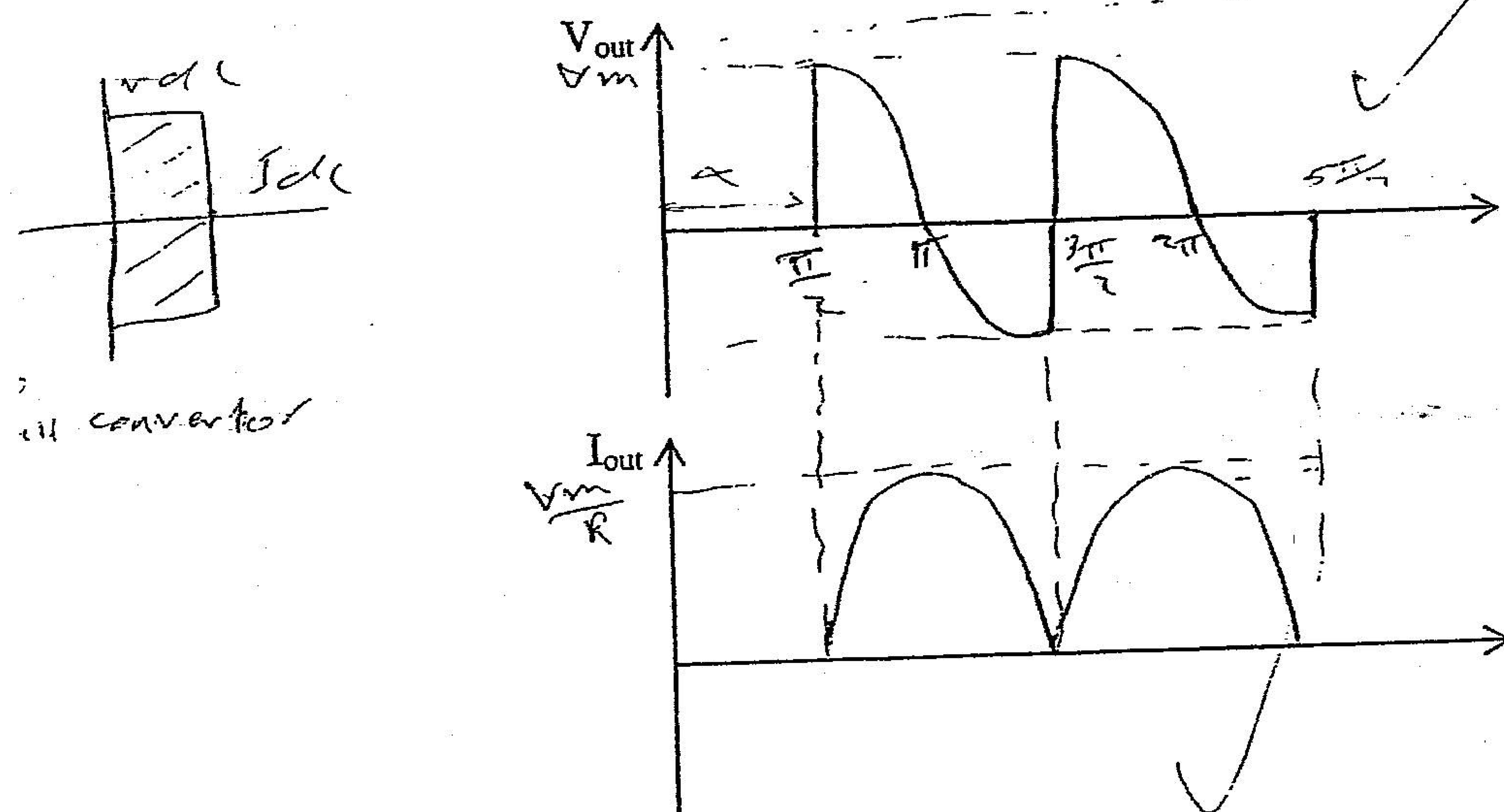
$PF = \frac{I_{s1}}{I_s}\cos\phi = \frac{\frac{4 I_a}{\sqrt{2}\pi}}{I_a} = 0.9003$

Q3. For a single-phase Bridge Controlled Rectifier: (3-marks) 3

a. Draw the power circuit of this rectifier with RL-load.



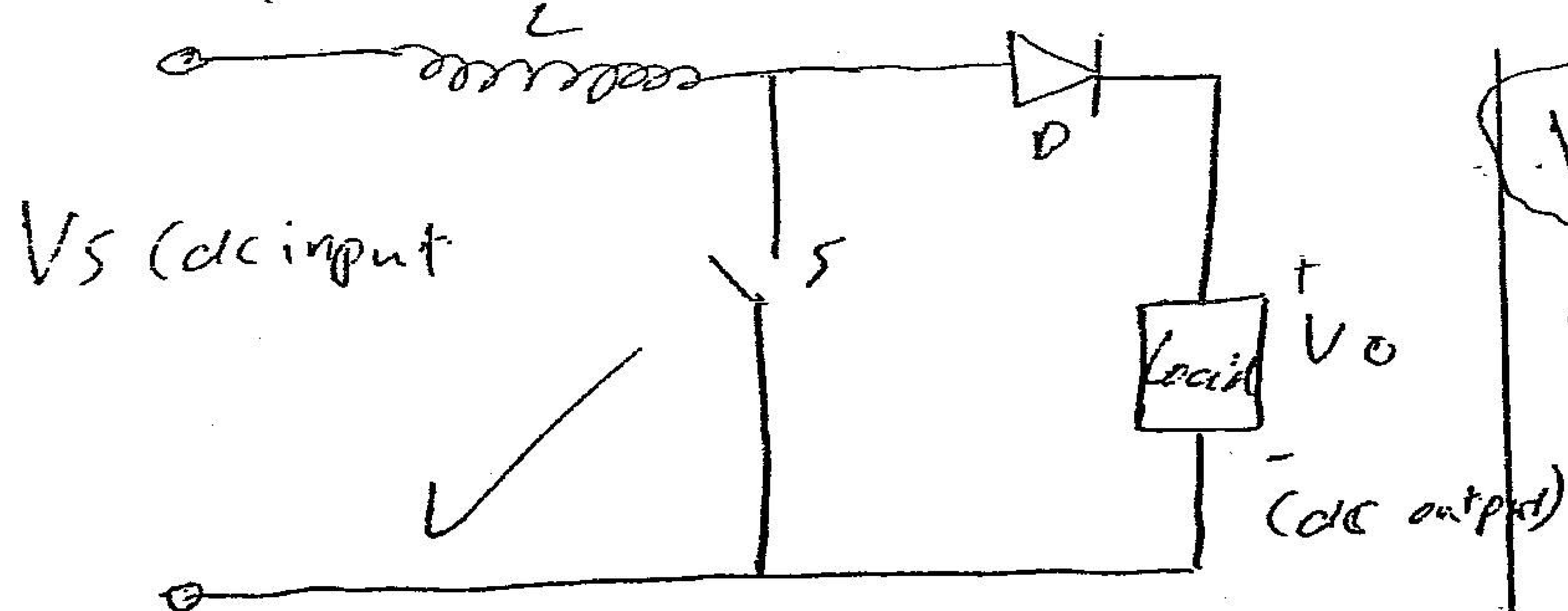
b. Draw the waveforms of output voltage and current for RL-load with $\alpha=\pi/2$:

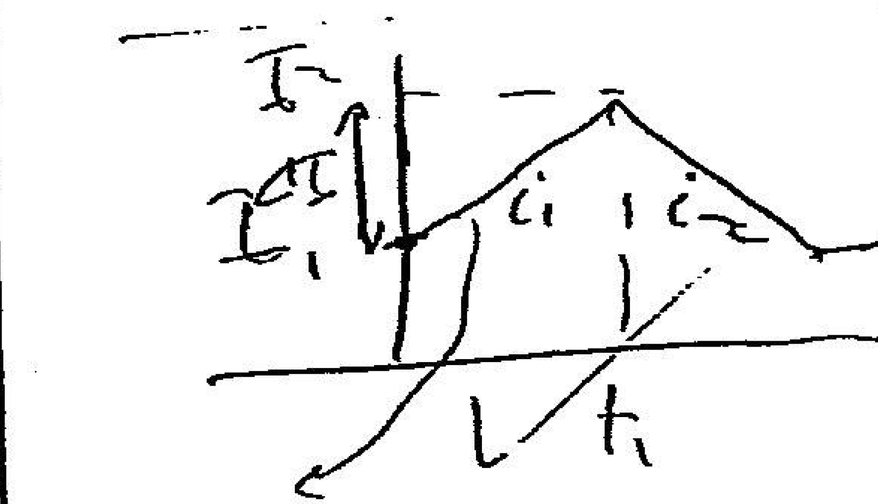


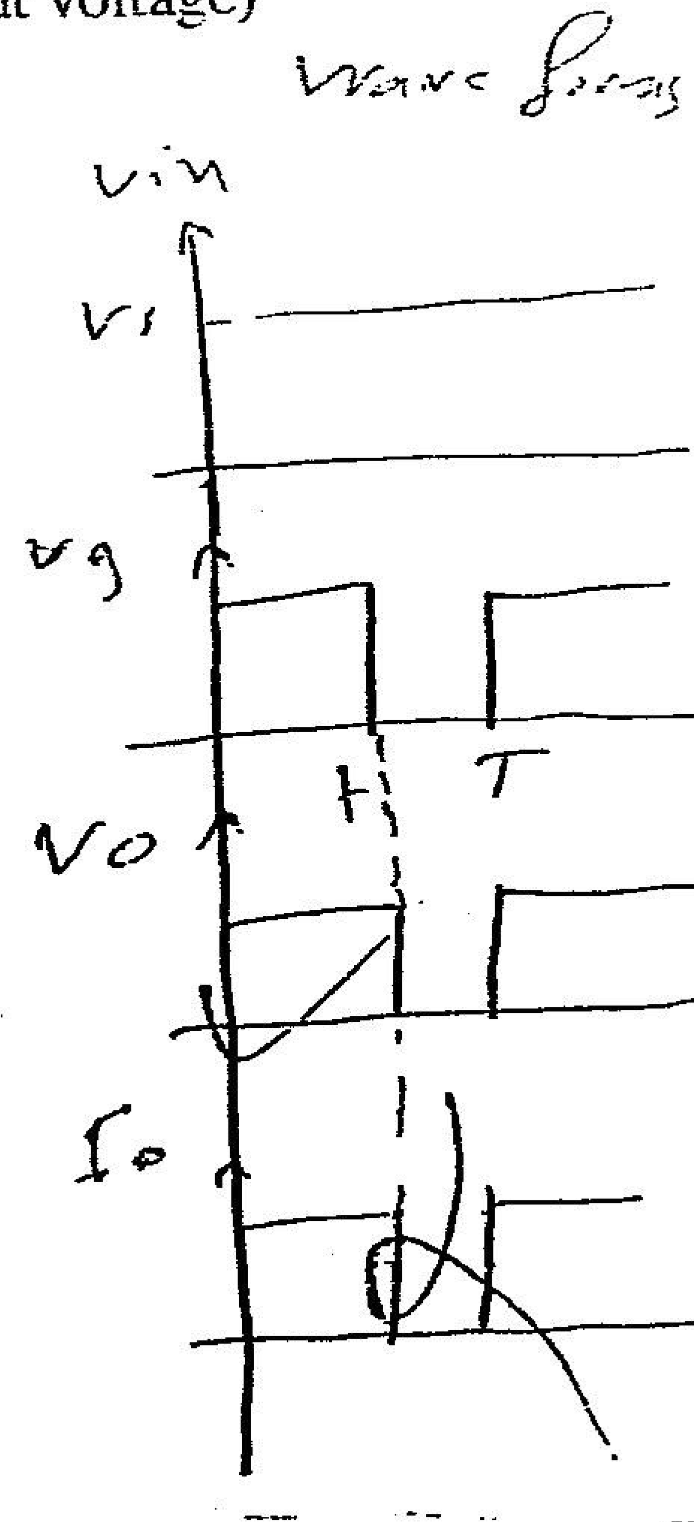
(load) (4)

Q4. Explain the principle of operation of step-up Chopper: **(6-marks)**

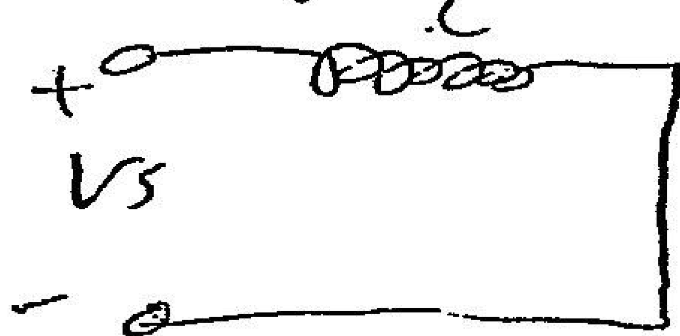
(Draw a circuit, How it works, waveforms (voltage and current), and explain the equation of output voltage)





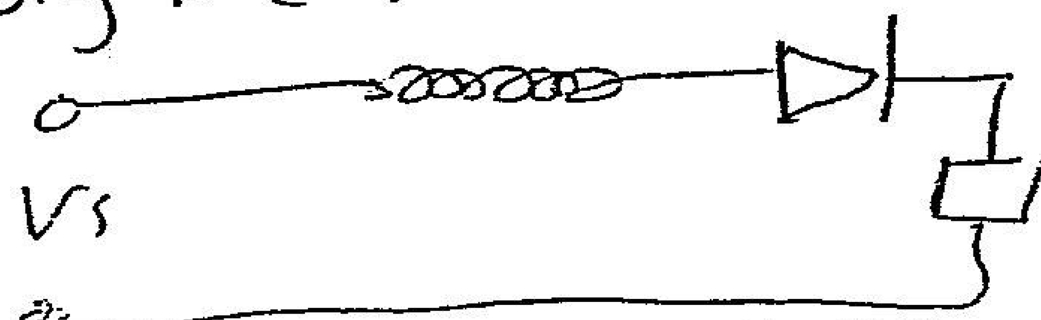


hen switch is closed current
ass the inductor through the
witch



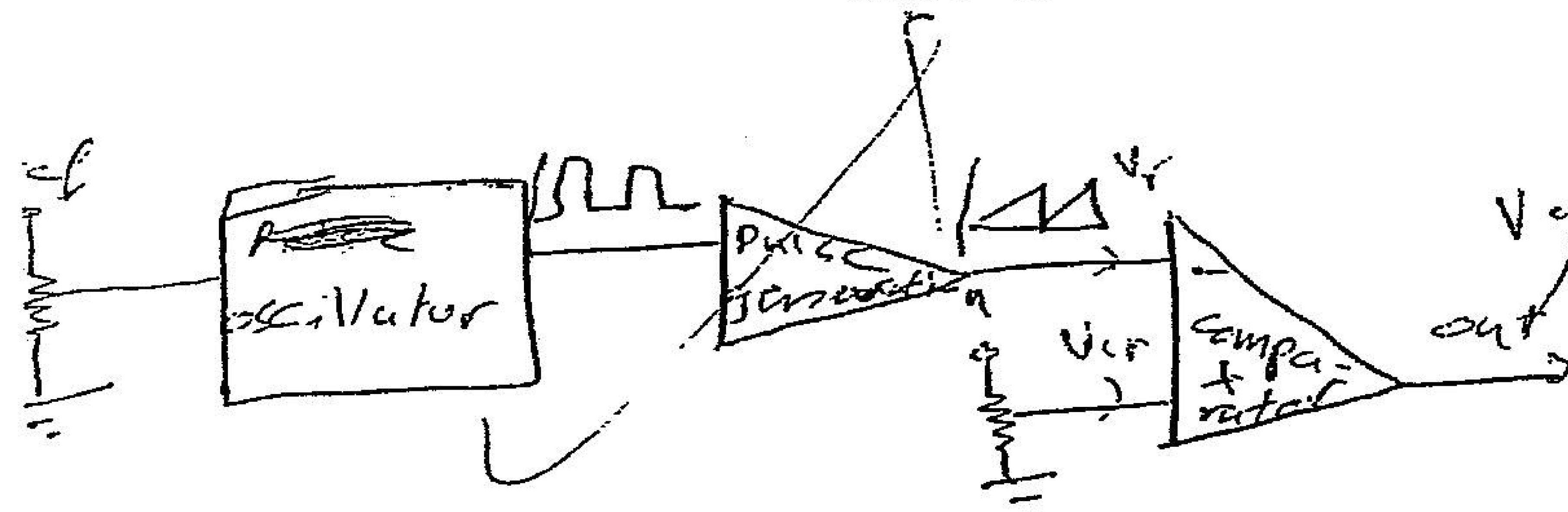
charging
current

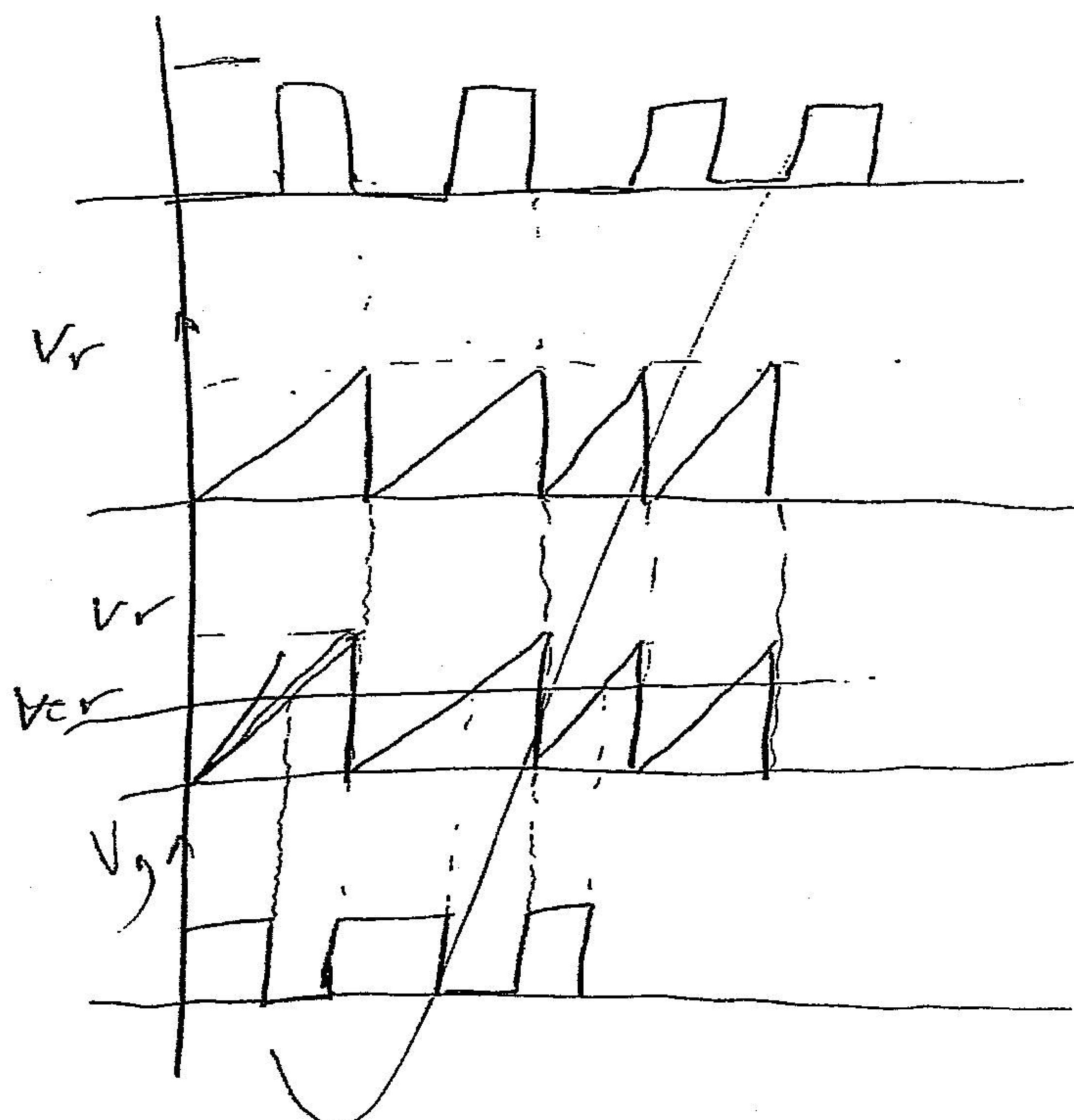
hen the switch is closed (mode 2)
rrent pass through the Diode and
oad



Q5. How to Generate the Duty Cycle of DC Converter: **(3-marks)** (2.5)

Show the Circuit and the Waveforms then explain them





e use the ossillator to have
pulse wave form and the
pass through a pulse generation
hen to comparator to compare
the signal with carrier voltage
ignal (Vr (reference voltage with
Vcr (carier ref voltage)
the Vr < Vcr (on time)
Vr > Vcr (off time)

Best Wishes

Dr. Anees Abu Sneineh